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Poster paper

Vacuum system of a Taiwan photon source-pulsed magnet

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The 3 GeV Taiwan Photon Source (TPS) is designed to produce an electron beam with small emittance and to be maintained with top-up operation. The vacuum systems of the TPS-pulsed magnets in the storage ring include four kicker ceramic chambers for the stored beam and an injection chamber for the injected beam. The prototypical design, manufacturing process and some test results for these chambers are described.

1. Injection straight section

A 12 m long straight section, as shown in figure 1, serves as the injection section for the Taiwan Photon Source (TPS) storage ring. Four injection kickers (K1–K4) are equipped to provide the stored beam a horizontal bump of 16.2 mm for beam injection off axis. The design philosophy is to maximize distances K1–K2 and K3–K4, so as to decrease the kicker strength. The aperture of the entire injection section has a racetrack shape of $68(\mathrm{H}) \times 20(\mathrm{V})$ mm, except for the injection chamber. The taper chamber at each end is equipped to convert the racetrack aperture to the standard elliptical aperture, $68(\mathrm{H}) \times 30(\mathrm{V})$ mm, of the TPS storage ring. A localized pumping configuration is adopted to handle the pressure of the injection section. The photon absorbers are located upstream from the non-cooled components (i.e. ceramic chambers and bellows) to prevent their being struck by synchrotron radiation. Under each absorber, a lumped Nonevaporable Getter (NEG) pump (GP500 MK5 St707) combined with an ion pump (speed $200\,\mathrm{l\,s^{-1}}$) is employed to evacuate the photon-stimulated desorption effectively from the photon absorbers.

2. Injection chamber

Version 1 of the TPS injection chamber follows the design of the Taiwan Light Source (TLS) (Chan *et al.*, 2009) with a beryllium window, so that the pressures of the transport line and storage ring are separated, and outgassing and trapped air from the laminated cores of the septum magnet are avoided. This design is reliable,

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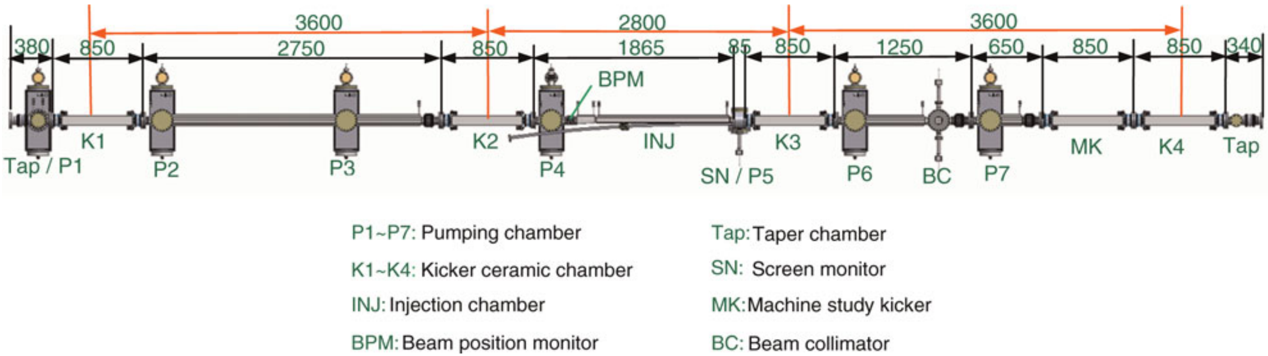

FIGURE 1. Layout of the TPS injection section.

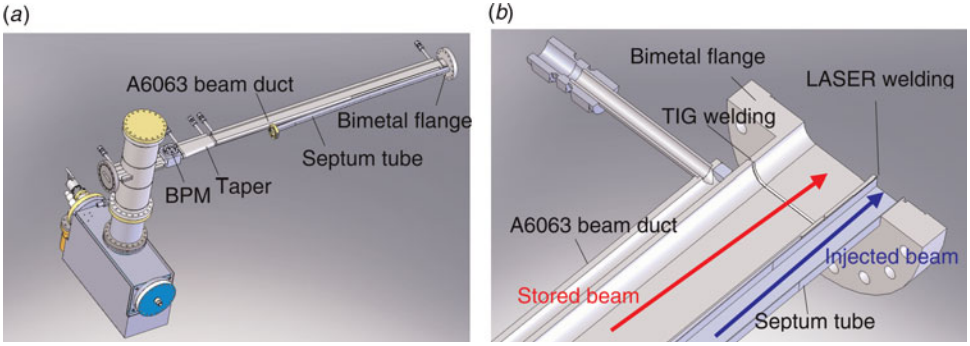

FIGURE 2. Schematic drawing (*a*) and cutaway view (*b*) of the TPS injection chamber.

i.e. only one small leak was found at the periphery of the beryllium window since the TLS was commissioned in 1993. The compromise is that the emittance of the injected beam will suffer. For this reason, we developed a windowless injection chamber, as shown in figure 2. The V-shaped injection chamber is integrated with a curved septum tube and an aluminium-alloy (A6063T5) beam duct. The septum tube, made of seamless stainless steel (SUS316, thickness 0.4 mm) with a rectangular aperture 20 (H) × 13(V) mm, is manufactured by cold extrusion from a round tube($\varphi = 20.4$ mm) before being bent to the proper curvature. The septum tube and an aluminium beam duct will be welded to a bimetallic Al/SS flange with Tungsten Inert Gas (TIG) welding and Light Amplication by Stimulated Emission of Radiation (LASER) welding, respectively, to form a windowless injection chamber. The uniformity of the thickness of the septum tube after extrusion is controllable within 5 % with ultrasonic measurement. The side wall of the aluminium-alloy beam duct is partially machined from 3 to 1 mm to provide space for the arrangement of the septum coil and the magnetic screening sheet (Huang *et al.*, 2010).

3. Kicker ceramic chamber

The ceramic chamber produced after forming and precise machining will be welded to bellows made of titanium (Ti) with interior Radio frequency (RF) contact and Ti flanges on each side. The Ti sleeves and the ceramic tube were joined by metallization of Mo/Mn + Ni, Ni plating, and then brazed with Ag–Cu alloy materials. The step at the joints is designed to be kept within 0.3 mm. The Ti bellows provide a maximum stroke +3/ − 5 mm for installation and baking. An interior titanium coating on the ceramic tube is adopted to minimize the impedance seen by the electron beam and the accumulation of charge on the ceramics. Some coating considerations, including the attenuation of the kicker field by the coating film and the heat from the beam–image currents and eddy currents, must be taken into account for evaluating the coating thickness (Chan *et al.*, 2009). The surface resistivity of the titanium film is selected to be 0.21 Ω per square according to the above coating considerations.

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